Ultra Long Duration Balloon Project

Instrument Evaluation Criteria (IEC)
January 27, 1998
Revision 2.1

820-ULDB-IEC-002.1

Prepared By: _____

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Instrument Evaluation Criteria 2.1

Revision 2.1 Change Control

Appendix B sections 2.3 and 2.4 revised to be
consistent with section 2.

Revision 2.0 Change Control

WEIGHTING CHANGES

Section 1 weight changed from 40 of 200 (20 percent) to
57 of 165 (34.5 percent).

Section 2 weight changed from 60 of 200 (30 percent) to
58 of 165 (35.2 percent).

Section 3 weight changed from 100 of 200 (50 percent) to
50 of 165 (30.3 percent).

1.1 weight changed from 4 to 10.

1.3 weight changed from 6 to 10.

1.8 weight changed from 3 to 10.

2.3 and 2.4 combined into new 2.3 "failure modes" and
weight changed to 10.

new 2.6 (old 2.7) weight changed from 6 to 10.

new 2.7 (old 2.8) weight changed from 6 to 10.

All 3.X subsection weights cut in half.

Appendix B and D weights changed to match above.

VERBAGE CHANGES

2.1 added replacement and refurbishment considerations.

new 2.7 added environmental requirements considerations.

Appendix B - 3.6 changed No Requirements to No Restrictions.

BEGIN SELECTION CRITERIA

Instrument Selection Evaluation Criteria
1/27/98
Revision 2.1

Weighting

1.0   Development Risk   **57 of 165**

**This area evaluates the risks to the project success that
are produced in the development phase for this system
element. The intention in this category is to only address
risks associated with development. This means that a system
element that is off the shelf would receive higher marks
in this category.**

1.1   Hardware Technology Level   10

This criteria addresses the level of technology required to
complete the development of the element being evaluated.
Generally, proven, existing technologies will result in a
lower risk (higher score) for the development phase.

1.2   Production Technology Level   5

This criteria addresses the technologies associated with the
manufacture of the element being evaluated. If new,
unproven production or fabrication technologies will be
required, the level of development risk is raised and the
score will be lower.

1.3   Development Schedule   10

The development schedule for this element will be evaluated
against the project schedule. The better the development
schedule for this element fits the project schedule (more
slack time to linked activities), the higher the score.

1.4   Required Development Skills   5

Skills that are required to complete the development effort
should be defined and readily available to the developers.
Poorly defined skill needs or lack of available skilled
personnel increase the risk that the development will not be
accomplished on time and result in a lower score.

1.5   Electrical Interface Technology   4

This criteria addresses the technology associated with the
electrical interfaces for this element. Proven power and
communications interface technologies are less risky to
implement and will result in higher scores.

1.6   Mechanical Interface Technology   4

This criteria addresses the technology associated with the
mechanical interfaces for this element. Proven mechanical
interface technologies are less risky to implement and will
result in higher scores.

1.7   Software Interface Technology   6

This criteria addresses the technology associated with the
software interfaces for this element. Standard, proven
formats and languages are less risky to implement and will
result in higher scores.

1.8   Software Development Level   10

This criteria addresses the required software development
for this system element. Systems that require more
extensive software development result in more development
risk and therefore lower scores.

1.9   Hazardous or Traced Material   3

Certain development processes require the handling of
hazardous or traceable materials. This can significantly
increase the risk that development efforts may not be
completed on schedule or within budget.

2.0   Flight Risk   **58 of 165**

**This evaluation area addresses the estimated risks of a
flight failure of the element being evaluated. The
assumption is that the system element has been produced as
proposed. The intention in this category is to only address
risks associated with flight performance of the element.**

2.1   Preflight Verification Capability   10

Highest scores in this evaluation category are given to
system elements that can be evaluated for flight performance
through ground testing. Elements that cannot be verified
until the demonstration flight would be the riskiest and
result in the lowest scores. The extent of instrument component
replacement and/or refurbishment after ground tests will be
factored into this criteria, with instruments requiring no
changes after ground tests receiving higher scores.

2.2   Dependence on Flight Operations   6

This evaluation criteria addresses the functional dependency
of the element on operational procedures and facilities.
The more dependent the successful operation of the system

element is on operational procedures or facilities, the
higher risk of flight malfunction.

2.3   Failure Modes   10

The impact of instrument component and/or subsystem failures
during flight is addressed in this criteria. The number of
single point failure modes will be assessed and the potential
for graceful degradation of instrument performance will be
assessed. Instruments with no single point failure modes
and/or designs which permit continued functionality at a
reduced level of performance if a failure occurs pose less
flight failure risk and are scored higher.

2.4   Proven Interfaces   6

The use of flight proven interfaces (mechanical, electrical,
software, communication) reduces the risk of interface
problems causing system element failures and therefore
receive higher scores.

2.5   Dependency on Software Function   6

High dependency on flight software for satisfactory
performance of a system element increases the risk of
failure. This includes Monitoring and Control functions.

2.6   Required Support Subsystem Functionality   10

High dependency on the operation of many supporting
subsystems increases the risk of failure.

2.7   Required Support Subsystem Complexity   10

Elements requiring support elements that are very complex in
their operation will have higher risk of failure and result
in lower scores. Thermal control requirements will be
assessed in this area with tighter temperature control
requirements resulting in lower scores.

3.0   Mission Risk   **50 of 165**

**This evaluation area addresses the estimated risks caused to
the mission due to requirements of the system element being
evaluated. The intention in this category is to only address
risks associated with mission risks generated by this
element.**

3.1   Launch Window Requirements   5

This criteria addresses the difficulty in meeting tight
launch window requirements. If the element being evaluated
requires very tight launch windows that would result in a

5

higher probability that a particular mission will not be accomplished on schedule and it will be scored lower.

| 3.2 | Recovery Requirements | 9 |

The more extensive the recovery requirements for mission success, the more mission risk and the lower the score.

| 3.3 | Ground Track Control Requirements | 5 |

System elements that require control of the ground track (for instance to stay within a latitude band) will increase the risk of mission failure.

| 3.4 | Altitude Requirements | 5 |

System elements that require higher altitudes for satisfactory performance will increase the risk of mission failure.

| 3.5 | Altitude Stability Requirements | 5 |

System elements that require tighter altitude stability for satisfactory performance will increase the risk of mission failure.

| 3.6 | Launch Location Requirement | 5 |

This criteria addresses the difficulty in meeting tight launch location requirements. If the element being evaluated requires specific, difficult launch locations, that would result in a higher probability that a particular mission will not be accomplished on schedule; it will be scored lower.

| 3.7 | Flight Hazards | 8 |

This criteria addresses the reliance of the evaluated element on materials or methods that could pose a flight safety hazard, thereby decreasing mission success probability.

| 3.8 | Ground Hazards | 8 |

This criteria addresses the reliance of the evaluated element on materials or methods that could pose a ground safety hazard, thereby decreasing mission success probability.

Appendix A: Support System Elements

Balloon Structure
Flight Train Configuration
Balloon Control Systems
Air & Surface Recovery Systems
Trajectory Control

Gondola Structure
Power System
Data Handling System
Telemetry System
Gondola Thermal Control
Detector Thermal Control
Attitude Control System
Ballast System
Ground Station Equipment
Control Electronics
System Software
Integration Systems
Gondola System Testing

Launch Systems
Launch Operations
Flight Support Operations
Recovery Operations
Operational Safety
International Coordination
Operational Facilities
Flight Planning

Appendix B: Evaluation Scoring Sheet

1.1   Hardware Technology Level   0 to 10
         0 = New Hardware Technology
         10 = Existing Hardware Technology
1.2   Production Technology Level   0 to 5
         0 = New Production Technology
         5 = Existing Production Technology
1.3   Development Schedule   0 to 10
         0 = Estimated Dev. Schedule Exceeds
         10 = Estimated Dev. Schedule Meets
1.4   Required Development Skills   0 to 5
         0 = New Development Skills
         5 = Development Skills Available
1.5   Electrical Interface Technology   0 to 4
         0 = New Technology Electrical Interface
         4 = Established Electrical Interface
1.6   Mechanical Interface Technology   0 to 4
         0 = New Technology Mech. Interface
         4 = Established Mech. Interface
1.7   Software Interface Technology   0 to 6
         0 = New Technology Software Interface
         6 = Established Software Interface
1.8   Software Development Level   0 to 10
         0 = Extensive Software Development
         10 = Minimal Software Development
1.9   Hazardous or Traced Material   0 to 3
         0 = Exotic Hazardous Materials
         3 = No Hazardous Materials
2.1   Preflight Verification Capability   0 to 10
         0 = Flight Test Only
         10 = Fully Pre-Flight
2.2   Dependence on Flight Operations   0 to 6
         0 = Dependent
         6 = Independent
2.3   Failure Modes   0 to 10
         0 = multiple single point failures and no
         graceful degradation
         10 = no single point failures and graceful
         degradation
2.4   Proven Interfaces   0 to 6
         0 = no interfaces flight proven
         6 = all interfaces flight proven
2.5   Dependency on Software Function   0 to 6
         0 = Extensive S/W Dependence
         6 = Low S/W Dependence
2.6   Required Support Subsystem Functionality   0 to 10
         0 = Large number of subsystems
         10 = Small number of subsystems
2.7   Required Support Subsystem Complexity   0 to 10
         0 = Complex
         10 = Simple

3.1	Launch Window Requirements	0 to 5
	0 = Narrow Launch Window	
	5 = Wide Launch Window	
3.2	Recovery Requirements	0 to 9
	0 = Absolute Requirement	
	9 = No Requirement	
3.3	Ground Track Control Requirements	0 to 5
	0 = Tight Control	
	5 = No Requirement	
3.4	Altitude Requirements	0 to 5
	0 = Tight Control	
	5 = No Requirement	
3.5	Altitude Stability Requirements	0 to 5
	0 = Tight Stability	
	5 = No Requirement	
3.6	Launch Location Requirement	0 to 5
	0 = Only One Location	
	5 = No Restrictions	
3.7	Flight Hazard Potential	0 to 8
	0 = Large	
	8 = Small	
3.8	Ground Hazard Potential	0 to 8
	0 = Large	
	8 = Small	

Appendix C: Scoring Procedure

Scoring will be accomplished as an IMT Engineering Management group task. The order of evaluation will be that all candidate science instruments will be evaluated for a particular evaluation element, then all will be evaluated for the next element, so that the relative evaluation for each criterion will be fair.

Appendix D: Summary

1.1	Hardware Technology Level	10
1.2	Production Technology Level	5
1.3	Development Schedule	10
1.4	Required Development Skills	5
1.5	Electrical Interface Technology	4
1.6	Mechanical Interface Technology	4
1.7	Software Interface Technology	6
1.8	Software Development Level	10
1.9	Hazardous or Traced Material	3
	Total of 1.0	**57**

2.1	Preflight Verification Capability	10
2.2	Dependence on Flight Operations	6
2.3	Failure Modes	10
2.4	Proven Interfaces	6
2.5	Dependency on Software Function	6
2.6	Required Support Subsystem Functionality	10
2.7	Required Support Subsystem Complexity	10
	Total of 2.0	**58**

3.1	Launch Window Requirements	5
3.2	Recovery Requirements	9
3.3	Ground Track Control Requirements	5
3.4	Altitude Requirements	5
3.5	Altitude Stability Requirements	5
3.6	Launch Location Requirement	5
3.7	Flight Hazard Potential	8
3.8	Ground Hazard Potential	8
	Total of 3.0	**50**

Total of Evaluation   **165**

END OF SELECTION CRITERIA